Certified
Naval Battle Groups

Sustainment

Interoperability

SE Process

Performance

Battle Force Interoperability Requirements

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Agenda

- Navy Battle Force Interoperability Requirements (BFIR) Background/Purpose

- Navy AAW Interoperability Requirements Analysis

- Navy AAW Force Interoperability Requirement

- Summary

Navy BFIR Background and Purpose

# *Navy Battle Force Interoperability Requirements (BFIR)*

- Quantification of Navy BFI performance
  - Characterize Navy BFI in a warfare mission context
  - Evaluate the value-added of improvements

- AAW Mission Focus
  - Evaluate ability of Navy BF to conduct Air Defense against threat raids
    - ➢ "Shared Track Picture" approach provides valuable insight into how/when the *Force* may act upon an object/track
  - Establish criteria (a yardstick) to engineer the Battle Force
    - ➢ Do we have enough Force Interoperability to meet the Navy's AAW Mission requirements ?
  - Basis for establishing measurable BG Certification Standards (AAW performance related)
    - ➢ Can the deploying Navy BF achieve its AAW Mission ?

> ### *We Fight as a Battle Force,*
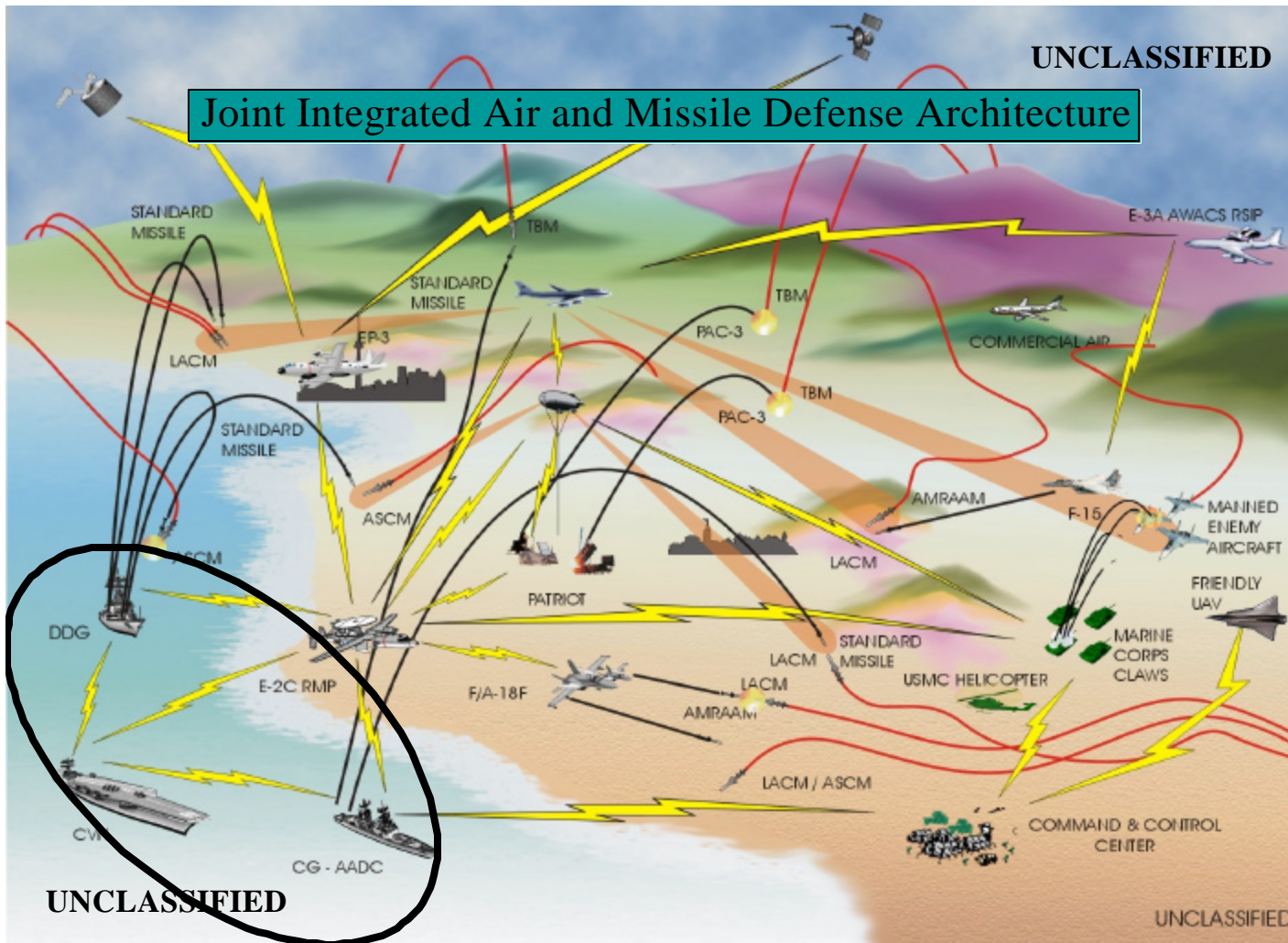> ### *Engineer the Battle Force as a System*

Establishing BFIR Metrics

- N8 Memorandum Dec 99
  - SEA 53 to Determine Force Level TAMD Measures
  - SEA 53 to Establish Force Level TAMD Expectations
  - *Established "Track Information Quality (TIQ)"*

- ASN(RDA) CEC ADM Memorandum Apr 00
  - Established Force I/O Benchmark Measures
  - Measure During CEC U/W Events
  - Provide LRIP-4 decision criteria
  - *Established "ASN RDA Interoperability metrics"*
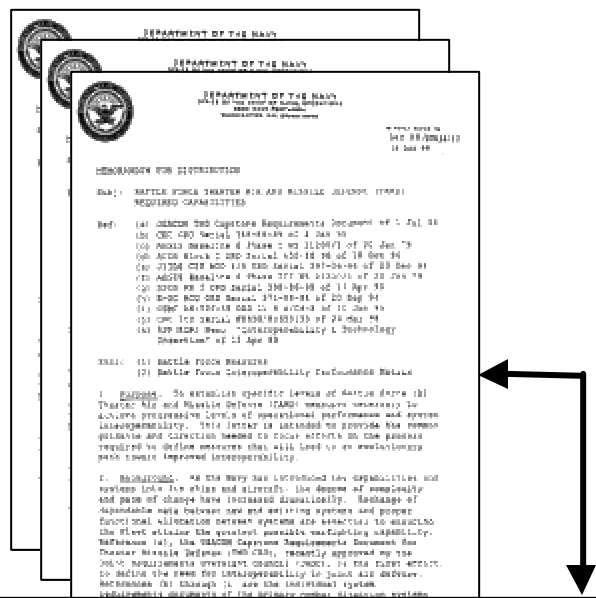
	Increment 0 2000 Baseline	Increment I 2001 w/o CEC	Increment IA 2001 with CEC	Increment II 2005+ Open Arch.
BG Configuration Elements **Including Approved TTP**	AEGIS B/L 5.3, and B/L 2.1 ACDS Block 0 Link 16 Model 4/5 E-2C Group I	AEGIS B/L 5.C, B/L 5.3 and B/L 6.1 ACDS Block 1 CEC B/L 2 Link 16 Model 4/5 E-2C Group I/II	AEGIS B/L 5.3, B/L 6.1 ACDS Block 1 CEC B/L 2.1 B/L 2.2 Link 16 Model 4/5 E-2C Group I/II	AEGIS B/L 6.3, B/L7 Ph 1 SSDS Mk II Navy Open Architecture CEC B/L 3 or JCTN B/L 1 Link 16 Model 5 or JDN B/L 1, E-2C Group II
Measurement Opportunities	2000, BGITs & BGSITs,	99 - 00 Underways, CEC OPEVAL, BGITs & BGSITs,	2000 Underways, BGITs; CEC OPEVAL,	BFITs & BGSITs, OPEVALs and Development Tests

Battle Force Tasks and Warfare Missions

Joint Integrated Air and Missile Defense Architecture

UNCLASSIFIED

UNCLASSIFIED

UNCLASSIFIED

MISSION

CAPABILITIES*

AAW

ASU

AMW

ASW

C2W

NSW

STW

TBMD
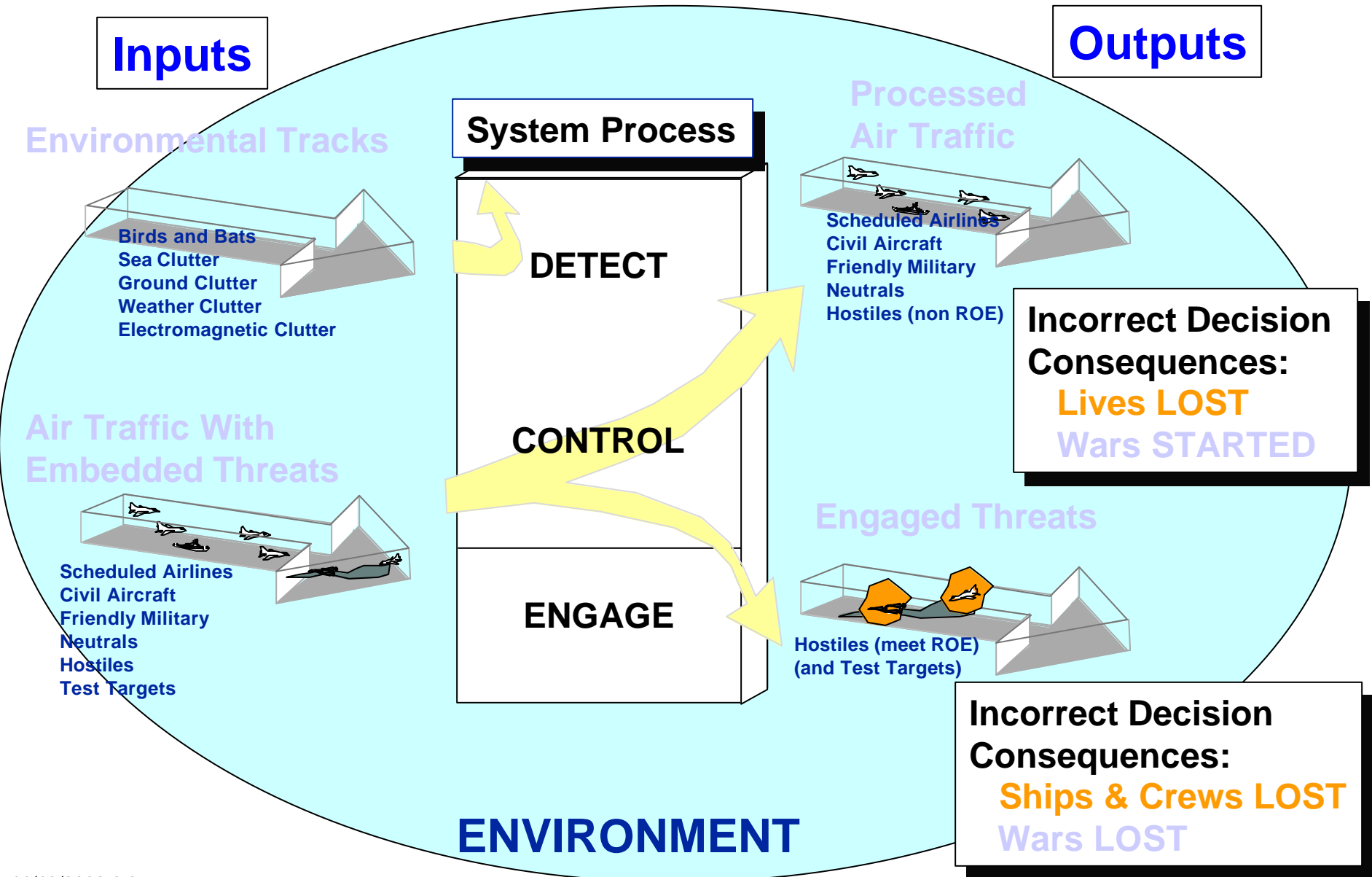
MIW

Accomplishing Mission Effectiveness Enabled By Interoperability

* OPNAVINST 3501.2J

A Complex Decision Making Environment

Inputs

Outputs

Environmental Tracks

System Process

Processed Air Traffic

Birds and Bats
Sea Clutter
Ground Clutter
Weather Clutter
Electromagnetic Clutter

DETECT

Scheduled Airlines
Civil Aircraft
Friendly Military
Neutrals
Hostiles (non ROE)

Incorrect Decision Consequences:
Lives LOST
Wars STARTED

Air Traffic With Embedded Threats

CONTROL

Engaged Threats

Scheduled Airlines
Civil Aircraft
Friendly Military
Neutrals
Hostiles
Test Targets

ENGAGE

Hostiles (meet ROE)
(and Test Targets)

Incorrect Decision Consequences:
Ships & Crews LOST
Wars LOST

ENVIRONMENT

Warfighter Impact

Can the Battle Force provide the information needed for both the BG Commander and the Unit to take action?
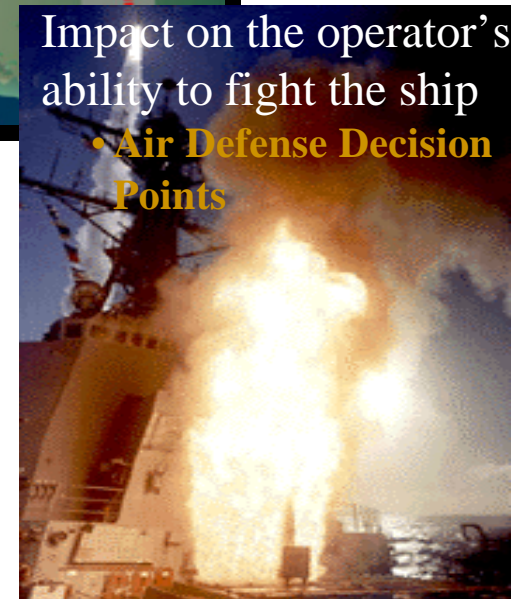
Air Corridor
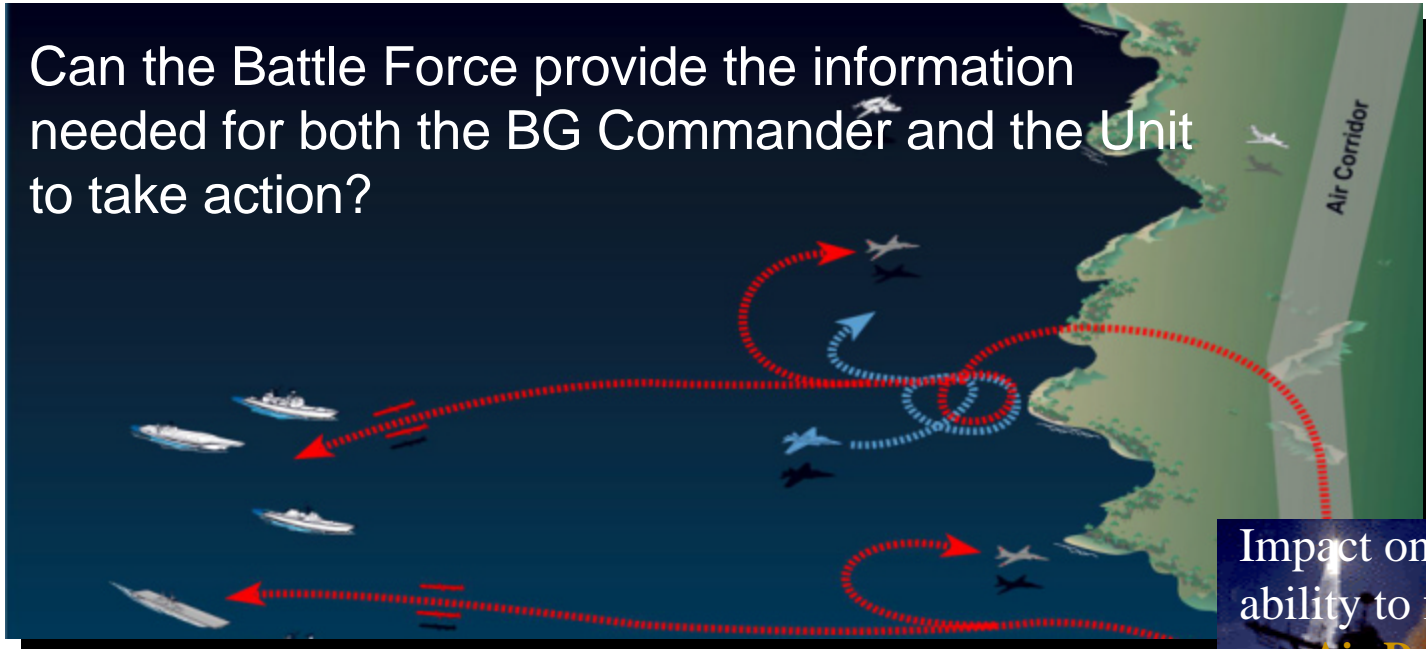
Impact on the operator's ability to fight the ship
- **Air Defense Decision Points**

Information Displayed to the Operator
- **Track Information Quality "TIQ"**
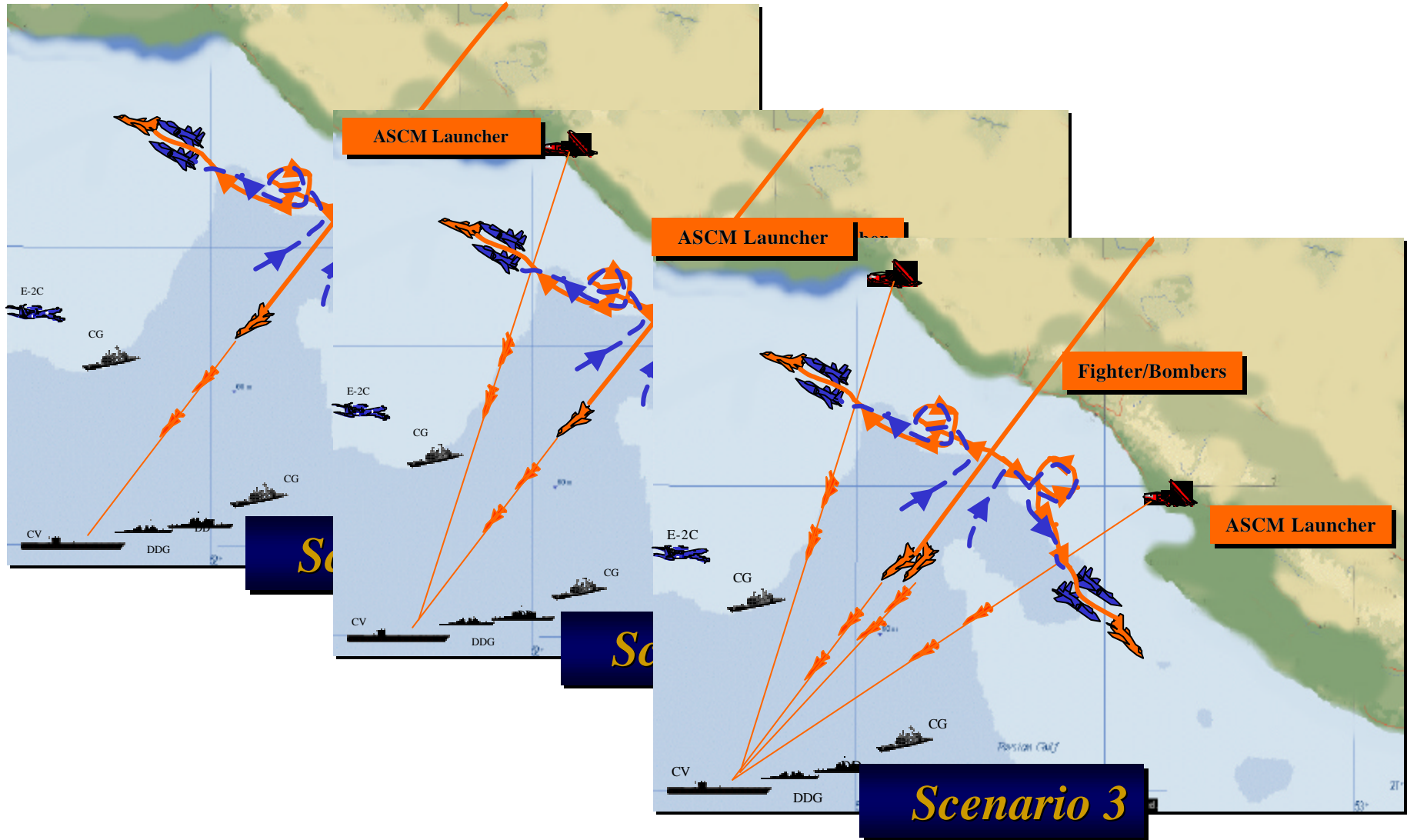
Navy AAW Interoperability Requirements Analysis

THREAT ENVIRONMENTS
AAW Capstone Requirements 1996

| Environment	Level of Violence	Scenarios	Naval Forces Committed
CONTESTED — **Multiple units at risk**	*War* — **Global/Major Regional**	• Large-scale enemy sorties • Engagements likely • Many high-tech threats • Highly coordinated multi-unit tactics	• Carrier battle groups • Surface action groups with air cover • Submarines
UNCERTAIN — **Individual units at risk**	*Crisis* — **Regional/Low Intensity Conflict**	• Small scale enemy sorties • Engagements possible • Some high-tech threats • Some coordinated tactics	• Carrier battle groups with fewer surface combatants • Amphibious ready groups with surface combatants • Surface action groups without air cover • Submarines
CONTROLLED — **Units seldom at risk**	*Peace* — **Operations Presence**	• Enemy sorties not expected • Possible random encounters • Few high-tech threats • Unconventional weapons/tactics more likely • Accidental attack /unintended targeting	• Carriers with surface combatants • Amphibious ready groups without surface combatants • Individual ships/ submarines

# BFIR AAW Scenarios
AAW Capstone Raid Requirements

Distributed Engineering Plant (DEP) Ground Truth Scenario

1177_2~4

NSWC
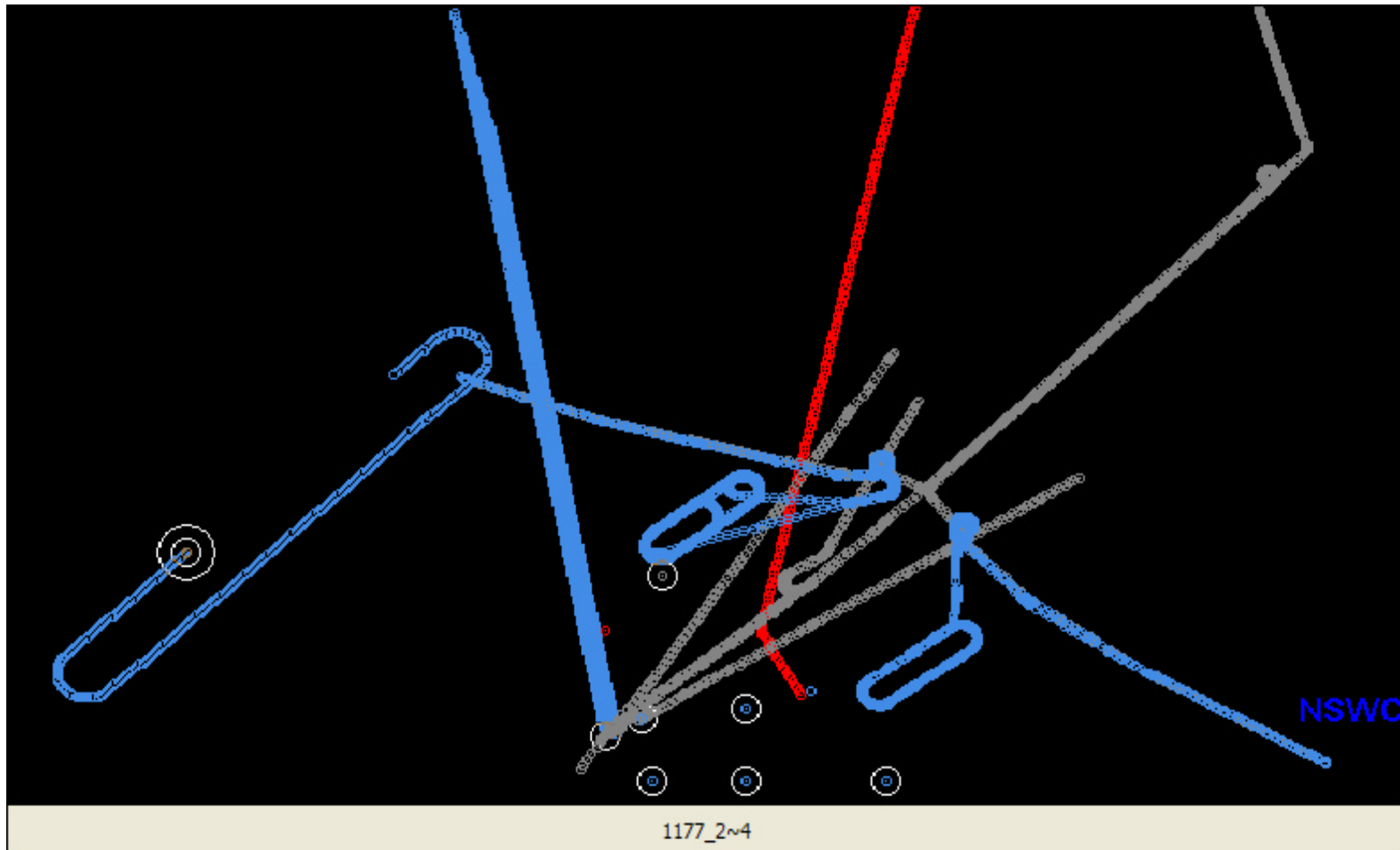
Force Protection Effectiveness
(Layered Defense & Interoperability)

AAW Capstone Requirements Document

◆ **Zero loss to Mission Essential Units with PRA greater than .xx**

◆ **To Be Effective, Each Layer Must Be Employed during some Critical Interval**

- ☐ **Too Soon, and the Target Is Not Yet Effectively Engageable**

- ☐ **Too Late, and the Layer Is No Longer Effective**

- ☐ **Timely and correct decision making via <u>Force Interoperability is key to effective layered defense</u>**
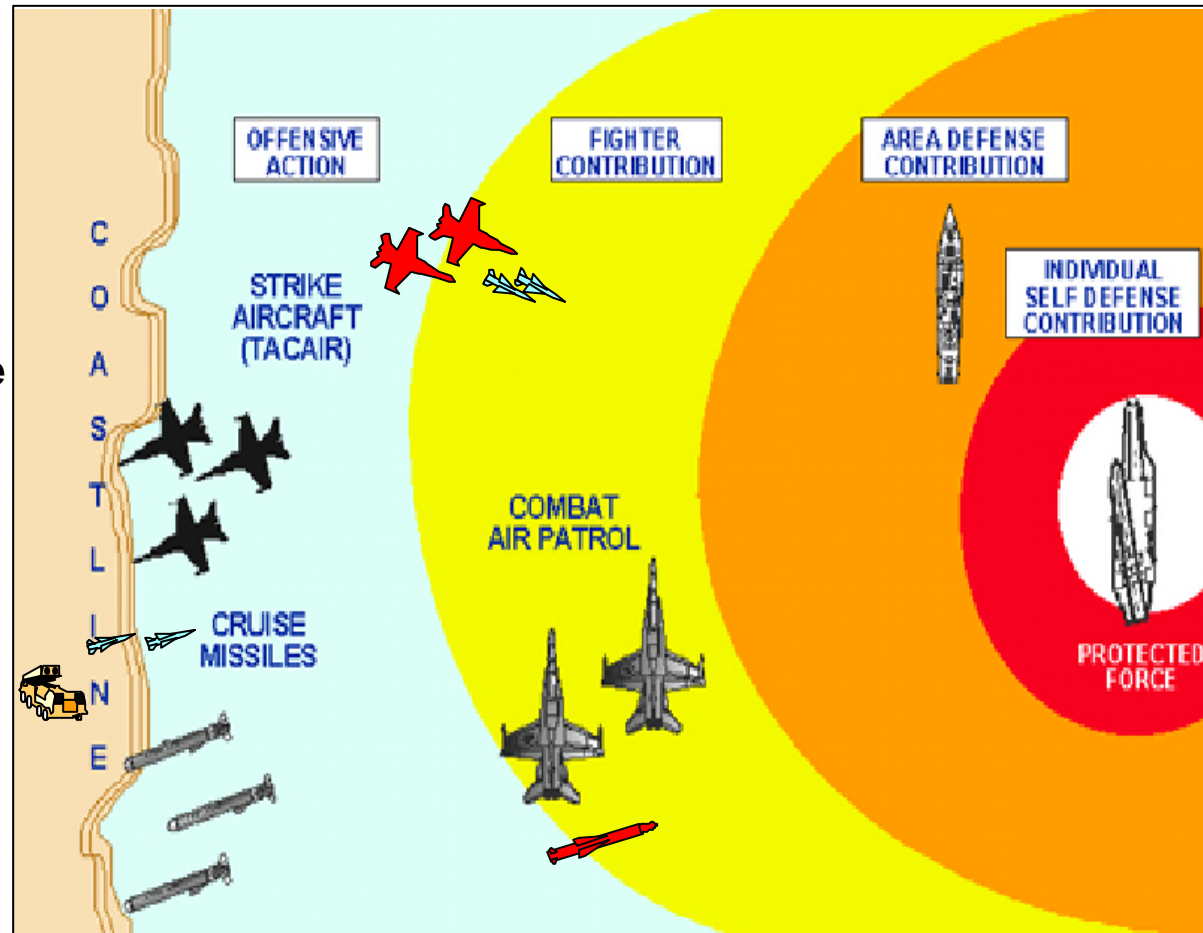
BFIR Defines The Interoperability Necessary For The Navy BF To Achieve Its Required AAW Mission

Battle Force Interoperability Requirements (BFIR) AAW Summary Metric
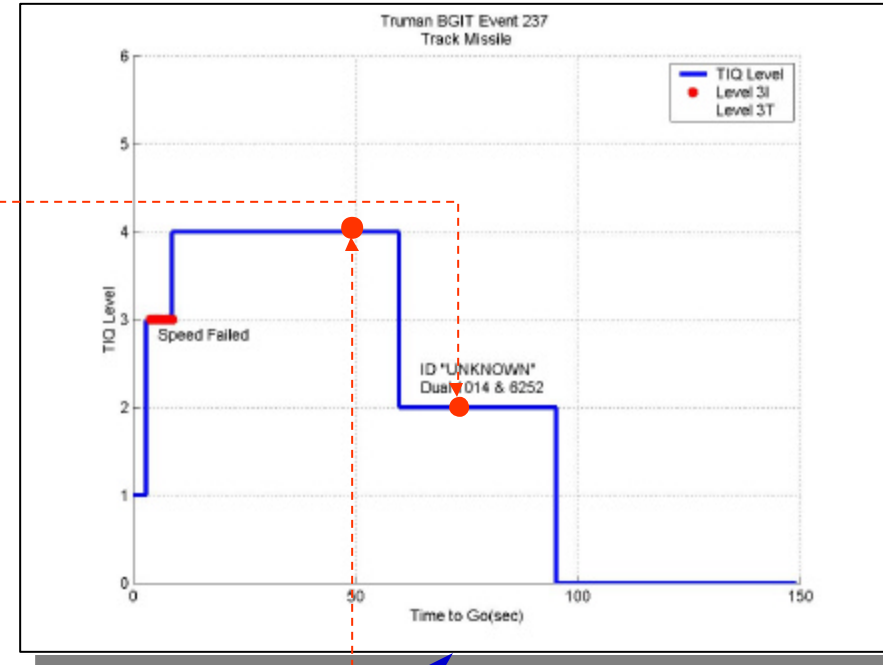
TIQ Level

5 — TBD

4 — Unambiguous Track

3 — 3t: High Fidelity Track | 3i: Correct ID

2 — Force Track Awareness

1 — Unit Track Awareness

Logic – "AND"

Logic – "OR"

3t: Single, common track (position/velocity correct), but with ambiguous ID

Friend? / Hostile? (TN 2031)

Hostile (TN 2031)

The Force has arrived at a single, common track with consistent, correct ID, position/velocity correct

3i: Dual track reports with a consistent correct ID

(TN 1020, 2031 & 1543)

A Link Track Number (LTN) on an object is shared by Battle Force units

At least one unit holds track on an object

INCREASING COMMON SITUATIONAL AWARENESS

Track Information Quality (TIQ)

Operator Impact

DDG 51 / AWS BL 5.3.7

CG 56 / AWS BL 2.10

Truman BGIT Event 237
Track Missile

Quantifies Warfighter Track Information Quality (TIQ) from CVN 75, CG 56, LHA 4, and DDG 51
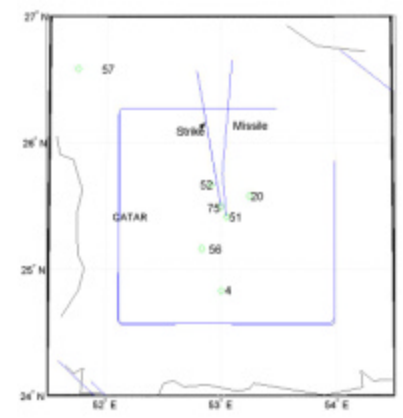
At-Sea Battle Group (BG) Interoperability Performance
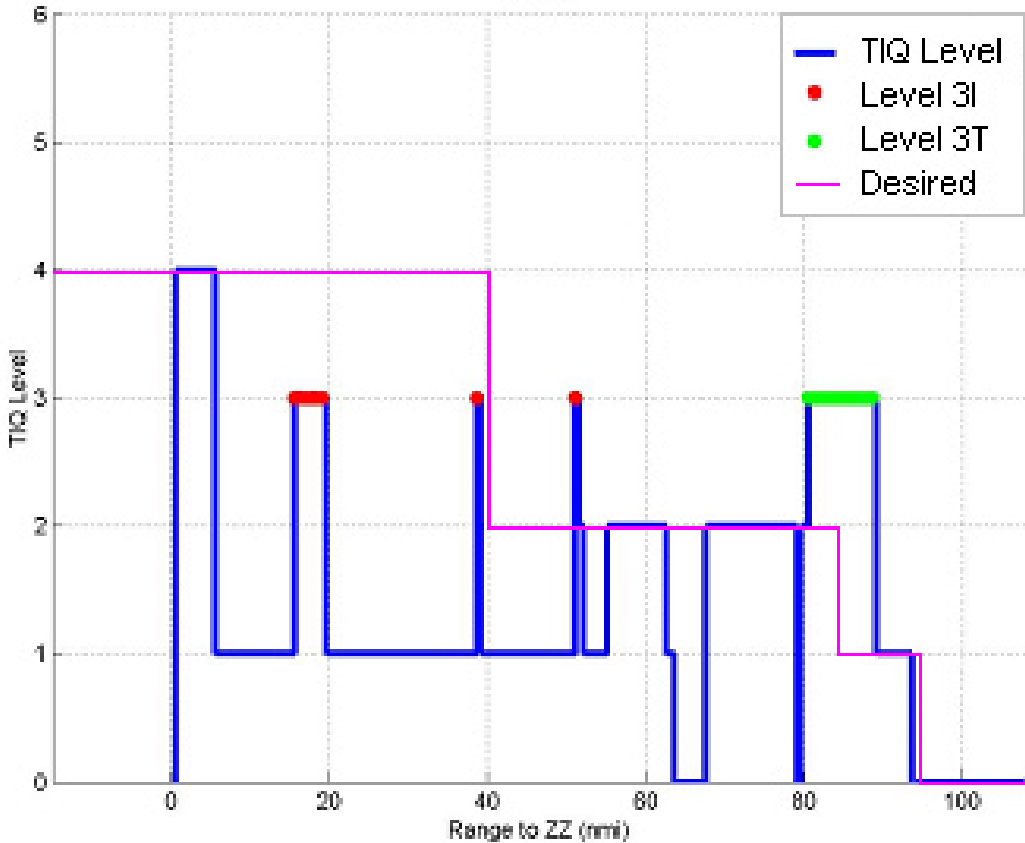
Navy AAW Force Interoperability Requirement

BFI AAW Draft Requirement

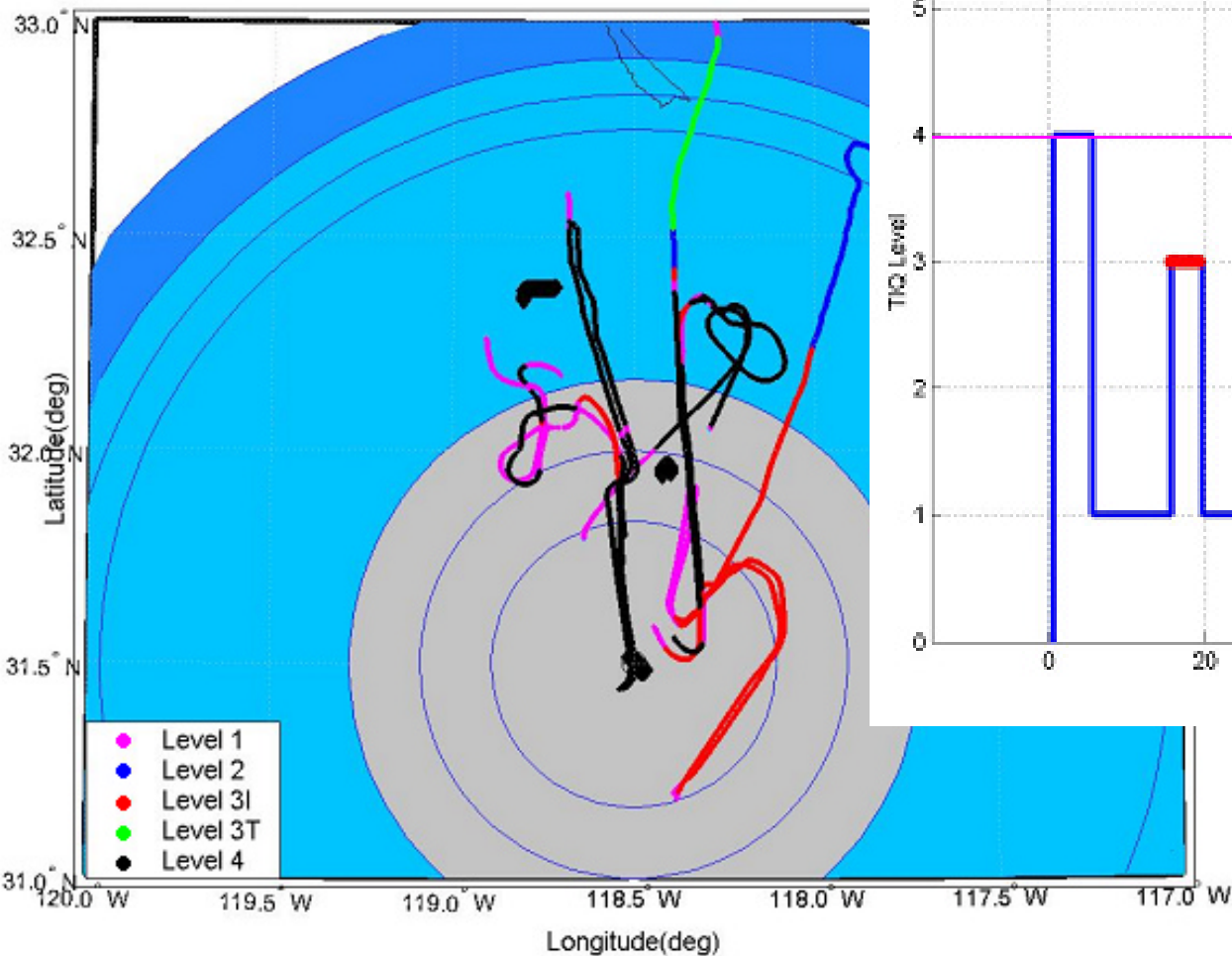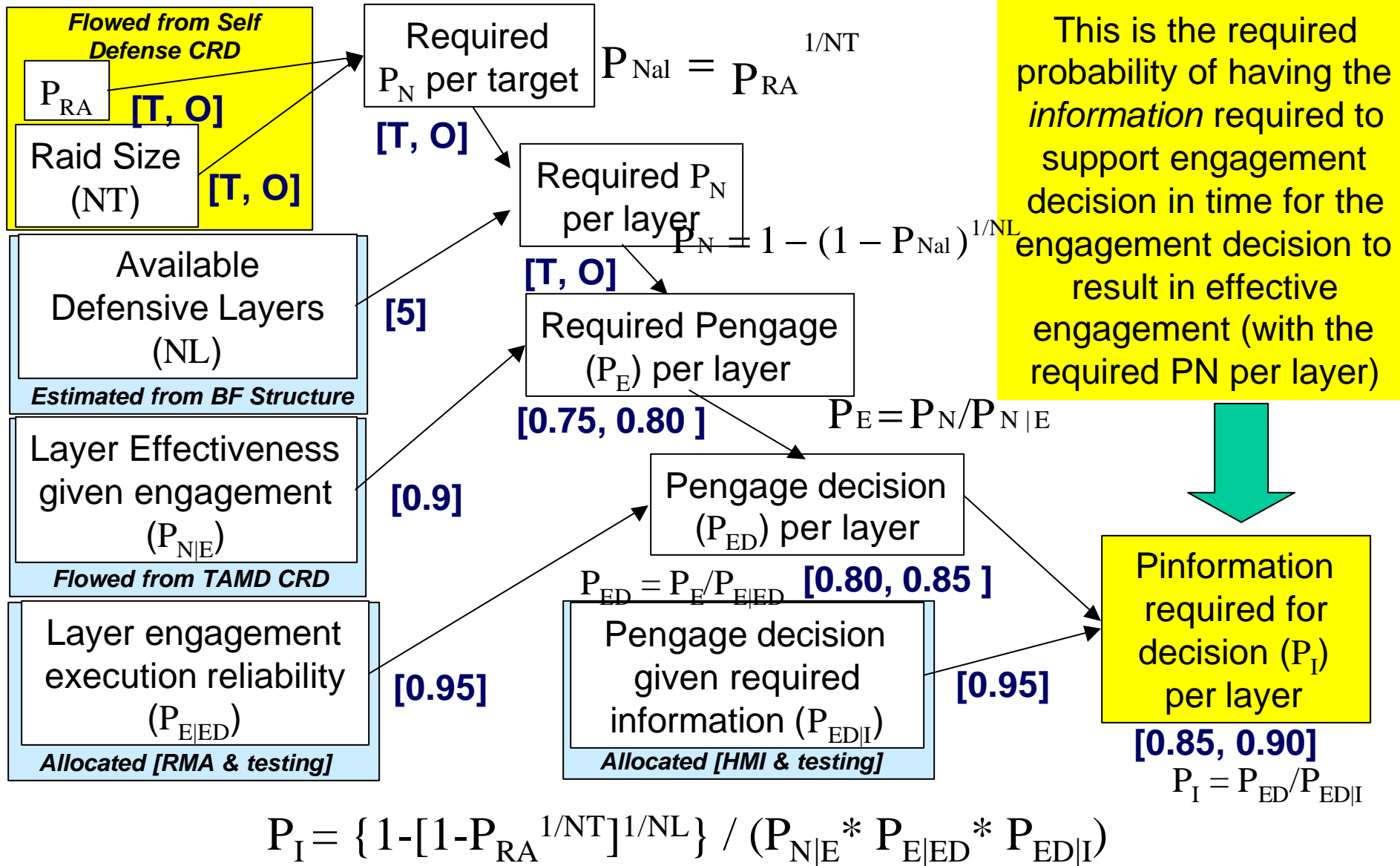Table Annex A.4- 2. AAW BFI Quantified
Requirements

Requirements	Threshold	Objective
Shared Track Picture (Shared Track Picture Quality - KPP, 50-100NM)	60%	85%
Common and Accurate Combat Identification	[CID CRD TBR]	[CID CRD TBR]
Effective Track Correlation	TBD	TBD
Common and Accurate Position, Navigation, and Timing	Non-numeric	Non-numeric
Consistent and Accurate Data Registration	Non-numeric	Non-numeric
Engagement Decision Effectiveness	80%	85%
Effective Integrated Fire Control Coordination	Non-numeric	Non-numeric
Common and Accurate Tactical Decision Aids/ Battle Management Aids	Non-numeric	Non-numeric
Common and Accurate Modeling and Simulation	Non-numeric	Non-numeric

STPQ - Fraction of Objects of interest in AOI for which force shares common, consistent, unambiguous, accurate representation

Derivation of STPQ Objective Requirement

Flowed from Self Defense CRD

P_{RA} **[T, O]**

Raid Size (NT) **[T, O]**

Required P_N per target **[T, O]**

$$P_{Nal} = P_{RA}^{1/NT}$$

Available Defensive Layers (NL) **[5]**

Estimated from BF Structure

Required P_N per layer **[T, O]**

$$P_N = 1 - (1 - P_{Nal})^{1/NL}$$

This is the required probability of having the *information* required to support engagement decision in time for the engagement decision to result in effective engagement (with the required PN per layer)

Required Pengage (P_E) per layer **[0.75, 0.80]**

$$P_E = P_N / P_{N|E}$$

Layer Effectiveness given engagement ($P_{N|E}$) **[0.9]**

Flowed from TAMD CRD

Pengage decision (P_{ED}) per layer **[0.80, 0.85]**

$$P_{ED} = P_E / P_{E|ED}$$

Layer engagement execution reliability ($P_{E|ED}$) **[0.95]**

Allocated [RMA & testing]

Pengage decision given required information ($P_{ED|I}$) **[0.95]**

Allocated [HMI & testing]

Pinformation required for decision (P_I) per layer **[0.85, 0.90]**

$$P_I = P_{ED} / P_{ED|I}$$

$$P_I = \{ 1 - [1 - P_{RA}^{1/NT}]^{1/NL} \} / (P_{N|E} * P_{E|ED} * P_{ED|I})$$

Summary

- **Draft BFIR document developed and under review (NAVSEA 53)**
  - AAW mission interoperability requirements documented in AAW Annex
  - Developed from AAW mission requirements
- **BFIR Metrics provide an understanding of the "Shared Track Picture"**
  - Basis for determining how and when the BF may act on a track
  - Can the force make force-level decisions and improve BG warfighting effectiveness ?
- **BFI Requirements are critical for engineering the Navy Battle Force as a system**
  - Interoperability required to perform Navy missions
- **DEP and underway Battle Group events analyzed**
  - KPPs/Requirement/Supporting metrics are measurable in Battle Groups/Forces
  - Analysis/engineering validated with live data and Fleet Feedback
    - 17 Battle Group events
- **BFIR AAW metrics part of Battle Group Work Ups and Combat System Development Efforts**
  - Battle Group System Integration Test (BGSIT)
  - Aegis DT/OT
- **Provides a basis for establishing BG Certification Standards**